Space Weather Technical Forecast

Issued on Wednesday, 06 July 2022 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight but increasing chance of R1-R2 radio blackouts. Chance of Minor Geomagnetic Storms. Increasing chance of Active fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours. The most significant events were a C9.8 at 05/0407UTC from AR3047 in the southwest quadrant, and a C7.5 at 05/1238UTC from AR3053. The C9.8 flare produced a Type II and IV radio burst along with a dimming in AIA 211. The spot responsible has been fading from a Bxo/Beta, and was otherwise unremarkable in the period. There are currently 7 sunspots on the disc, none of which are looking especially complex, although AR3053 near the northeast limb is difficult to fully assess at this time due to the viewing angle.
The C9.8 flare gave a very faint partial halo in coronagraph imagery, which suggests that we may see a glancing blow from this CME at Earth on 08 July.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 by DSCOVR, saw the tail end of CME effects becoming ambient, before the likely start of a CIR, ahead of the CH97/+ HSS. The wind speed was initially slightly elevated just above 400 km/s, declining to just below 350 km/s. The density was initially mostly average, but started to rise from 05/1800 UTC, peaking around 13 ppcc. The IMF was weak throughout but with a recent increase to 5 nT, with the north-south component varying very weakly and mainly northward directed. The phi angle was predominantly negative (towards the Sun), with some brief variations, then switched to positive at 05/2150 UTC. Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, remained at Background levels throughout the period.
The high energy electron flux (greater than 2MeV) has also been at background levels through the last 24 hours. Electron fluence was well below the Active (1e8 integrated pfu) threshold. Observed fluence was 2.44e6 integrated pfu at 06/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low, with a Slight Chance of isolated M-class flares. An increase is probable through the period as returning regions potentially rotate onto the eastern limb.

Solar Wind / Geomagnetic Activity: Earth may experience a glancing blow from the CME which occurred at 05/0407 UTC from AR3047. This CME was difficult to assess, however it gave a faint partial halo in SOHO imagery and as such a low confidence glancing blow is possible on 08 July. Otherwise, solar winds are anticipated to increase from background to elevated levels as CH97/+ becomes geoeffective, most likely during Day 1 (06 July). Elevated or slightly elevated wind speeds could last for much of this period.
Overall, geomagnetic activity is likely to increase early on Day 1 to be Quiet to Active possibly with the odd G1/Minor Storm interval, these most likely on Days 1 and 3 (06 and 08 July) as the

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HSS arrives on Day 1 and the possible CME on Day 3. In addition, there is just a slight chance of G2/Moderate Storms on Day 3 in association with the CME.

Energetic Particles / Solar Radiation: In the absence of any significant sunspot development, the high energy proton flux (greater than 10 MeV) is expected to remain at background levels. High energy electron flux (greater than 2MeV) is currently at background levels. However, there is an increasing chance of high (1000 pfu) flux levels being reached during the forecast period due to anticipated high speed stream influence. Electron fluence is considered most likely to remain below the Active (1e8 integrated pfu) threshold, but with an anticipated rising trend. Potential CME effects on Day 3 (08 July) may temporarily suppress electron levels however.

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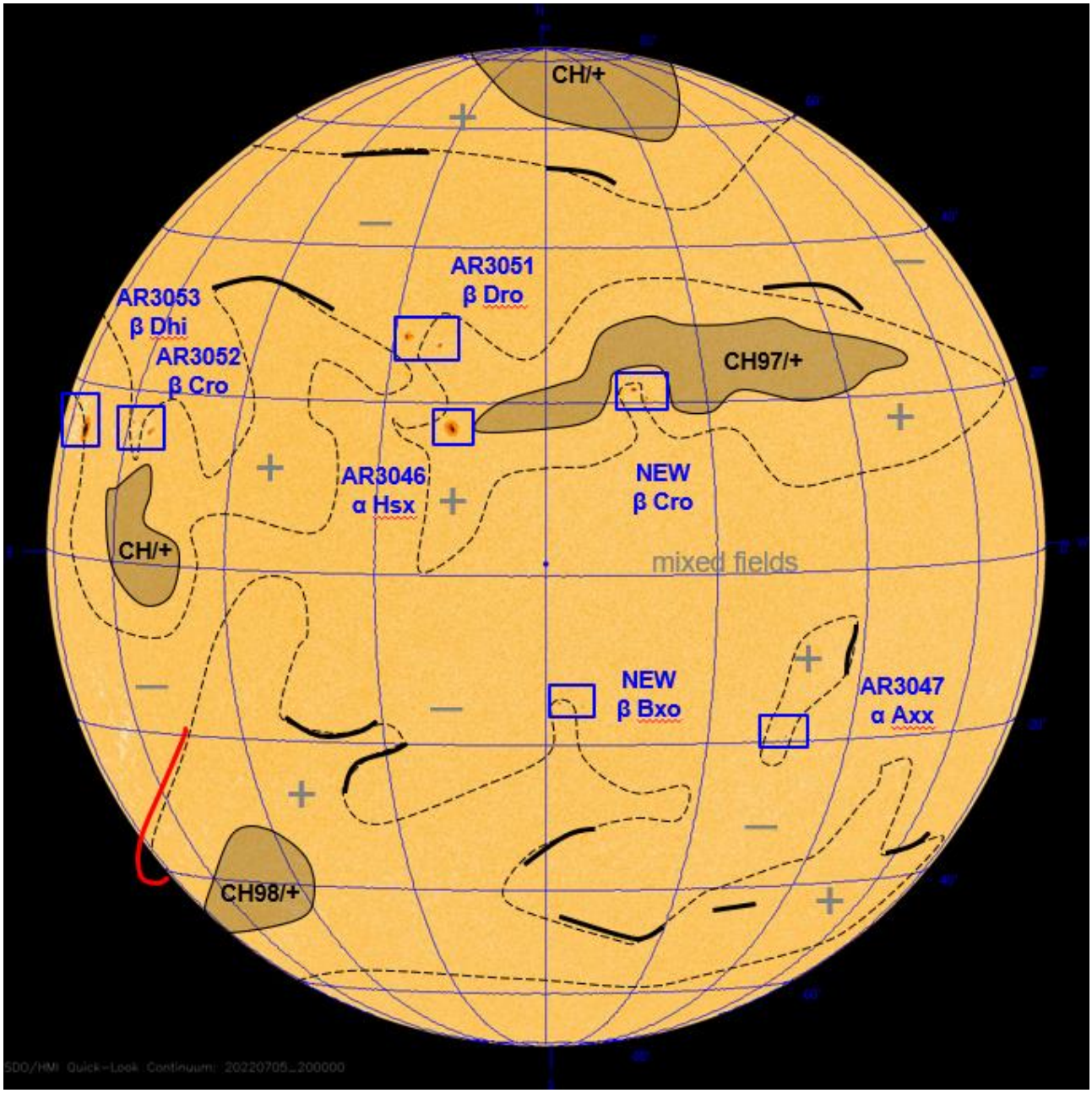
Figure 1. Solar Analysis Valid 05/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Earth may experience a glancing blow from a CME which occurred at 05/0407 UTC from AR3047. This CME was difficult to assess as it was faint and contaminated by a far sided CME which was visible at the same time. However, it gave a faint partial halo in SOHO imagery and as such a low confidence glancing blow is possible on 08 July.

Otherwise, solar winds are anticipated to increase from background to elevated levels as CH97/+ becomes geoeffective, most likely during Day 1 (06 July) as there are signs of a CIR currently occurring. The longitudinal extent of this CH suggests that elevated or slightly elevated wind speeds could last for much of this period. However, recent STEREO A data is not showing any particular enhancement, although STEREO is further south than Earth relative to the Sun's equator (with CH97/+ in the northern solar hemisphere).

Overall, geomagnetic activity is likely to increase early on Day 1 to be Quiet to Active possibly with the odd G1/Minor Storm interval, these most likely on Days 1 and 3 (06 and 08 July) as the HSS arrives on Day 1 and the possible CME on Day 3. In addition, there is just a slight chance of G2/Moderate Storms on Day 3 in association with the CME.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	30	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
05/0934	Partial	AR3047	SW quadrant	630 km/s	08/1200 UTC	Low confidence glancing blow possible.

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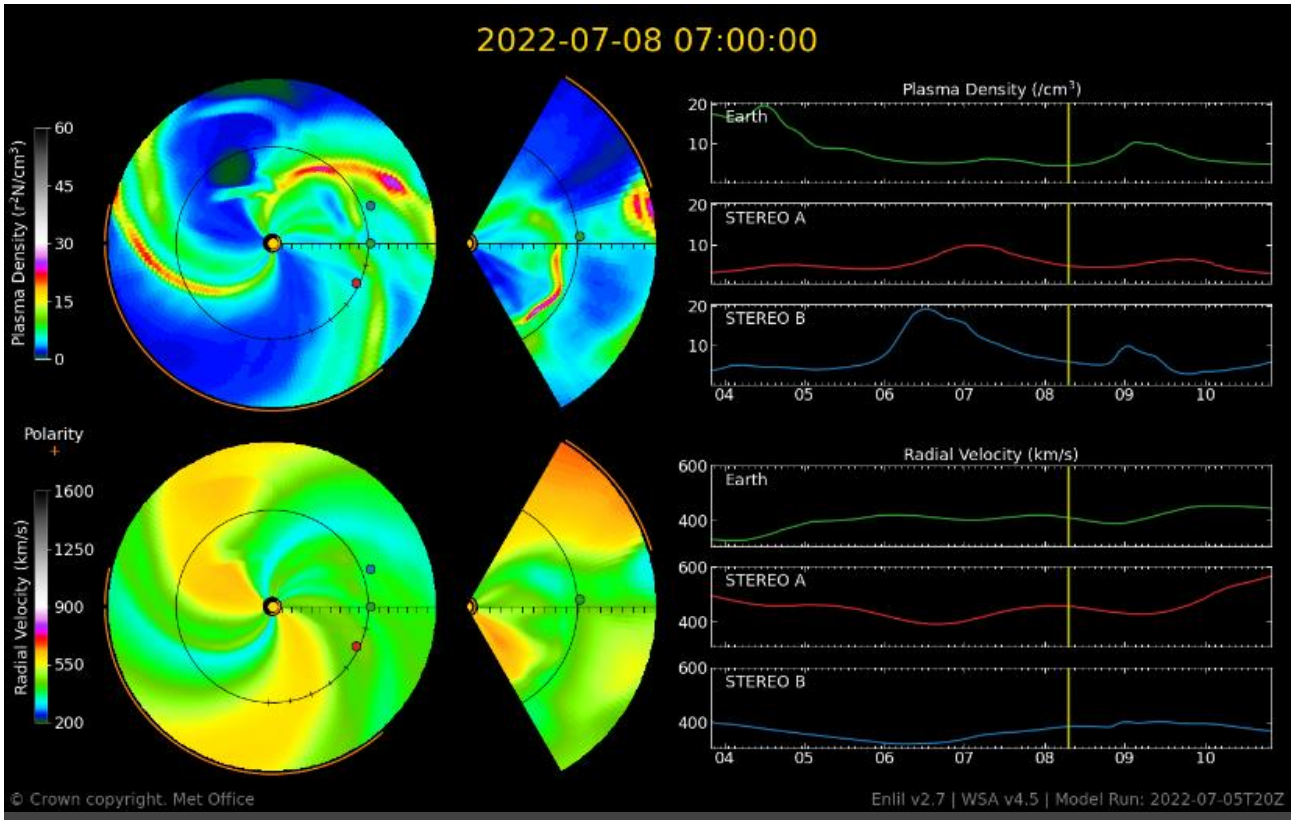
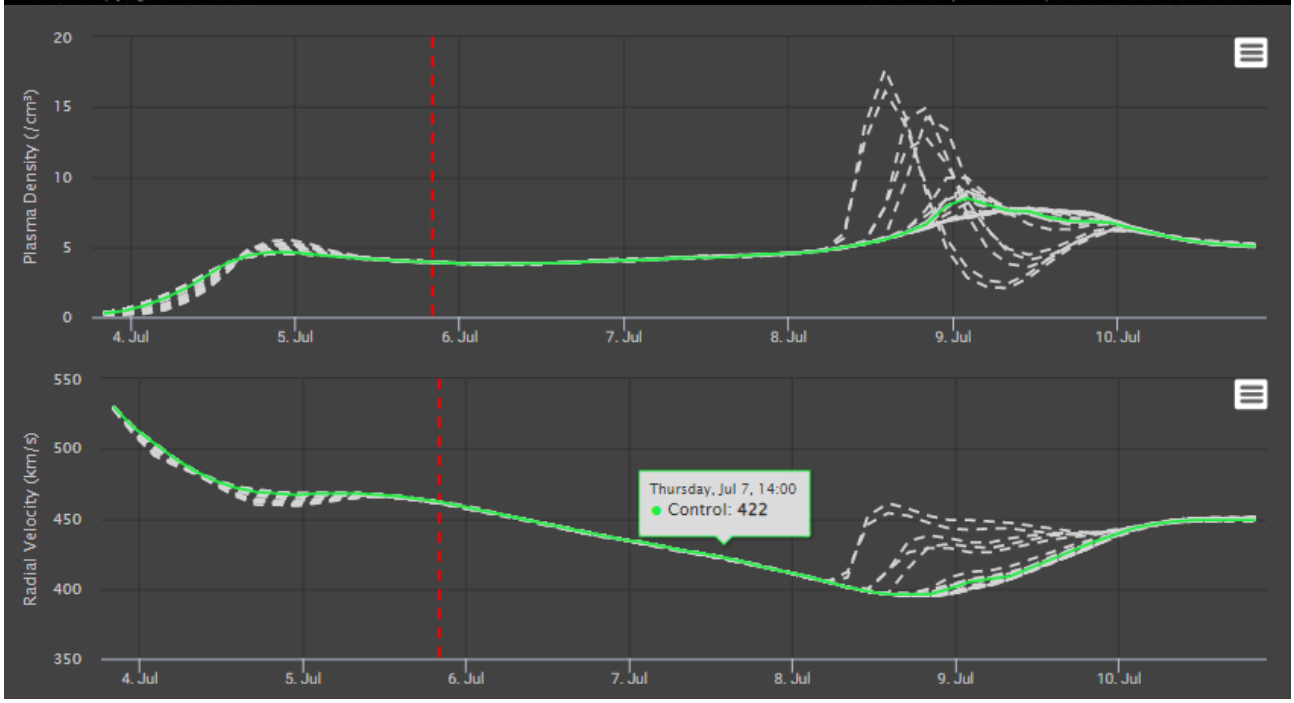
Figure 2: Enlil and ensemble showing possible CME glancing blow on 08 July





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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

There are currently seven sunspot regions on the visible disc, which should increase in the coming four days, with potential returning sunspot groups due over the eastern limb and no groups of significance departing. The most interesting region currently visible is AR3053 (Dhi/Beta), although AR3047 gave a high C-class flare despite its apparently simple configuration. The contribution from eastern limb arrivals is difficult to judge until they become visible, but a slight uptick in probabilities is suggested to reflect this risk.

C-class flares are expected, with a slight but increasing chance of M-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	25	30	30
Very Active	R3 to R5 X Class	No	1	2	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels, and will most likely remain at this level through the period, in the absence of any significant sunspot development. AR3047's near M-class flare does not appear to have produced any proton enhancement at the time of writing, and this region is now fading. The main regions of interest are all in the eastern hemisphere at present, with any increase in proton risk not expected until the very end of the period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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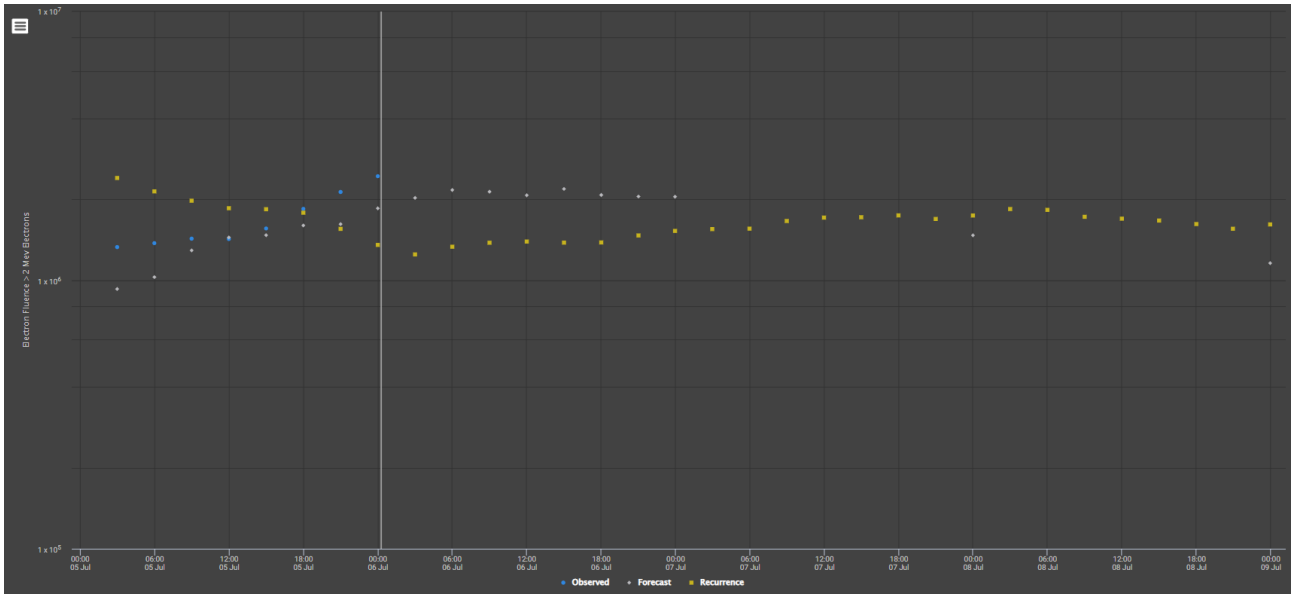
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) is currently at background levels. Electron flux is likely to increase through this period with anticipated elevated wind speeds from CH97. However, a low confidence CME glancing blow is possible early on Day 3 (08 July), which would suppress flux levels if it occurs. Overall, High (1000 pfu) flux levels may be reached during this period, but with some uncertainty due to the potential CME effects.

Electron fluence is currently well below the Active threshold. Fluence is considered most likely to remain below the Active threshold through the period, although this carries a degree of uncertainty due to the significant difference in coronal hole extent compared to the previous rotation and the possibility of CME effects. An upward trend is assessed as being likely following anticipated coronal hole connection but with low confidence for the magnitude of this. REFM is not currently showing any increase in fluence levels as we haven't yet seen an increase in wind speeds, so this is likely to be an underestimate at this time.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	20	30	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: REFM is currently showing no increase in fluence, which is considered an underestimate. This is likely because we haven't yet seen an increase in wind speeds.



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